

1. Initially a tank contains 10 000 litres of liquid. At the time $t = 0$ minutes a tap is opened, and liquid then flows out of the tank. The volume of liquid, V litres, which remains in the tank after t minutes is given by

$$V = 10\,000 (0.933^t).$$

- (a) Find the value of V after 5 minutes. (1)
- (b) Find how long, to the nearest second, it takes for half of the initial amount of liquid to flow out of the tank. (3)
- (c) The tank is regarded as effectively empty when 95% of the liquid has flowed out. Show that it takes almost three-quarters of an hour for this to happen. (3)
- (d) (i) Find the value of $10\,000 - V$ when $t = 0.001$ minutes.
- (ii) Hence or otherwise, estimate the initial flow rate of the liquid.
Give your answer in litres per minute, correct to two significant figures. (3)
- (Total 10 marks)**

2. Find the **exact** value of x in each of the following equations.

(a) $5^{x+1} = 625$

(b) $\log_a (3x + 5) = 2$

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(Total 6 marks)

3. The population of a city at the end of 1972 was 250 000. The population increases by 1.3% per year.

(a) Write down the population at the end of 1973.

(b) Find the population at the end of 2002.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(Total 6 marks)

4. A population of bacteria is growing at the rate of 2.3% per minute. How long will it take for the size of the population to double? Give your answer to the nearest minute.

Working:

Answer:

.....

(Total 4 marks)

5. Michele invested 1500 francs at an annual rate of interest of 5.25 percent, compounded annually.

(a) Find the value of Michele's investment after 3 years. Give your answer to the nearest franc.

(3)

(b) How many complete years will it take for Michele's initial investment to double in value?

(3)

(c) What should the interest rate be if Michele's initial investment were to double in value in 10 years?

(4)

(Total 10 marks)

6. Each year for the past five years the population of a certain country has increased at a steady rate of 2.7% per annum. The present population is 15.2 million.

- (a) What was the population one year ago?
- (b) What was the population five years ago?

Working:

Answers:

(a)

.....

...

(b)

.....

...

(Total 4 marks)

7. A group of ten leopards is introduced into a game park. After t years the number of leopards, N , is modelled by $N = 10 e^{0.4t}$.

- (a) How many leopards are there after 2 years?
- (b) How long will it take for the number of leopards to reach 100? Give your answers to an appropriate degree of accuracy.

Give your answers to an appropriate degree of accuracy.

Working:

Answers:

(a)

.....

...

(b)

.....

...

(Total 4 marks)